ABSTRACT

This thesis investigates the application of quantum inspired evolutionary algorithms in the synthesis of sequential circuits. Sequential digital systems represent a class of circuit that is able to execute operations in a particular sequence. In sequential circuits, the values of output signals not only depend on the values of input signals but also on the current state of the system. The increasingly high requirements regarding the functionality and performance of digital systems demand more efficient designs. The design of these circuits, when implemented manually, became slow and thus the importance of tools for automatic synthesis of circuits grew rapidly. These tools known as ECAD (Electronic Computer-Aided Design) are computer programs usually based on heuristics. Recently, evolutionary algorithms also began to be used as a basis in ECAD tools developing. These applications are referenced in literature as evolutionary electronics. The algorithms most commonly used in evolutionary electronics are genetic algorithms and genetic programming. This work presents a study of the application of quantum inspired evolutionary algorithms as a tool for automatic synthesis of sequential circuits. This class of algorithms uses the principles of quantum computing to improve the performance of evolutionary algorithms. Traditionally, the design of sequential circuits is divided into five main steps: *(i)* State machine specification; *(ii)* Reduction of states; *(iii)* State assignment; *(iv)* Control logic synthesis and *(v)* Implementation of the state machine. The proposed algorithm AEICQ is used in the state assignment design step. The choice of an optimal state assignment is treated in the literature as an issue still unresolved. The state assignment chosen for a particular state machine has a direct impact on the complexity of its control logic. The results show that the state assignment obtained by AEICQ in fact leads to the implementation of circuits of less complexity when compared with the ones generated from assignments obtained by other methods. The AEICQ is also used in the control logic synthesis of the state machine. The circuits evolved by AEICQ are optimized according to the area occupied and the propagation delay. These circuits are compatible with the circuits obtained by other methods and in some cases even higher in terms of area and performance, suggesting that there is a potential for application of this class of algorithms in the design of electronic circuits.

Keywords: quantum computation, evolutionary computing, digital systems, sequential systems, state machine, state assignment, evolutionary electronics.